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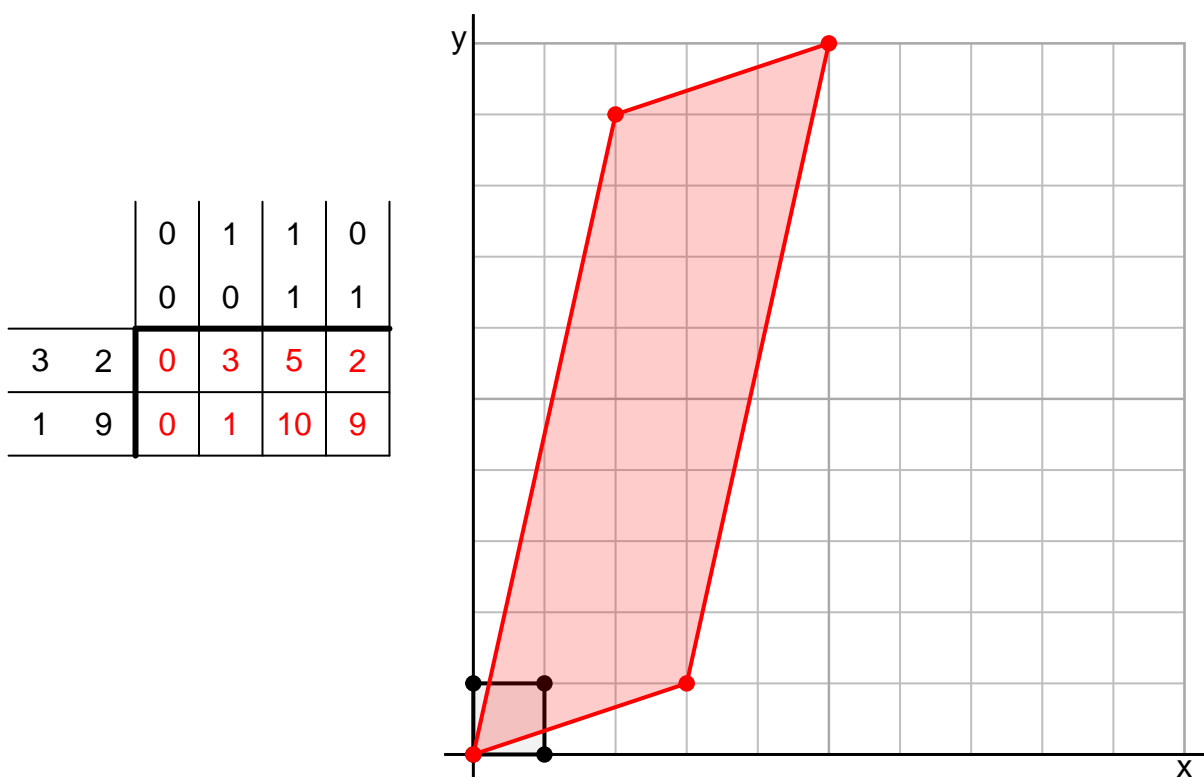
s19 Matrix Exam (solution v110)

Let the 2×4 matrix U represent four points in the xy -plane (so each column represents a point). When those four points are connected as a convex polygon, matrix U represents a unit square. Also, let the 2×2 matrix L represent a linear transformation.

$$U = \begin{bmatrix} 0 & 1 & 1 & 0 \\ 0 & 0 & 1 & 1 \end{bmatrix} \quad L = \begin{bmatrix} 3 & 2 \\ 1 & 9 \end{bmatrix}$$

Let matrix $P = L \cdot U$, so P is found by matrix multiplication of L times U . Matrix P also represents 4 points of a polygon. Use the diagram below to calculate the elements of P . Then, draw the polygon represented by matrix P on the xy -plane below. Notice I have already drawn the unit square represented by matrix U .

1. Multiply $L \cdot U$ and draw resulting polygon.



2. What is the area of the convex polygon represented by matrix P ? *Hint: the area equals the absolute value of the determinant of matrix L .*

$$\text{area} = \det(L) = (3 \cdot 9) - (2 \cdot 1)$$

$$\text{area} = 25$$

The triangle shown below is composed of the three points represented by matrix $A = \begin{bmatrix} 0 & 5 & 10 \\ 5 & 5 & 10 \end{bmatrix}$. In order to reflect over the x axis and then rotate by 36.87° counterclockwise we can multiply by the transformation matrix $R = \begin{bmatrix} 0.8 & 0.6 \\ 0.6 & -0.8 \end{bmatrix}$.

3. Calculate the matrix $R \cdot A$.

$$R \cdot A = \begin{bmatrix} 3 & 7 & 14 \\ -4 & -1 & -2 \end{bmatrix}$$

4. Draw the triangle represented by $R \cdot A$.

